SEVERE WEATHER DETECTOR AND ALARM

This application is a continuation of 09/246,784 filed 2/1/1999 now 6,076,044, which is a continuation of 08/799,838 filed 2/13/97, now 5,978,738.

BACKGROUND OF THE INVENTION

1. FIELD OF THE INVENTION

The present invention relates to an unmanned weather detecting and reporting station. More specifically, the novel station has apparatus for detecting severe weather conditions such as tornadoes and lightning. The station has sensors for sensing certain critical ambient characteristics, a microprocessor for comparing sensed data to a database, a radio for receiving weather data from remote broadcasting sources, and apparatus for broadcasting inferred and reported weather patterns.

2. DESCRIPTION OF THE PRIOR ART

Severe weather conditions can arise quite suddenly, with potentially great catastrophic consequences in financial and human cost. To avoid or minimize injury and damage from sudden, violent weather phenomena, it is desirable to be able to predict such occurrences. If weather conditions can be predicted, it is possible in many instances to take steps to mitigate undesirable consequences of the unleashed forces.

An example of a field of activity which could benefit greatly from such analysis and warning of weather conditions is that of aviation. Take off and landing are subject to disruption from extreme weather conditions. Aircraft may be rerouted or their departures and landings postponed if

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significant threats from weather are identified. Therefore, a need clearly exists for detection and annunciation of extreme weather conditions.

The prior art has suggested a number of weather analysis and warning systems. United States Patent Number 5,105,191, issued to Edgar L. Keedy on April 14, 1992, describes apparatus and method for detecting and indicating severe air disturbances such as shear winds and clear air turbulence. This invention does not address electrical phenomena, as it is primarily intended for providing information essential for take off and landing decisions for advising aircraft pilots. By contrast, the present invention considers different parameters, and detects electrical phenomena such as lightning.

Apparatus and method for identifying tornadoes are set forth in United States Patent Number 5,355,350, issued to Henry E. Bass et al. on October 11, 1994. The subject method employs detection and analysis of ambient sound for amplitude and frequency which may be associated with tornadoes. By contrast, the present invention considers other parameters of ambient conditions, and predicts both tornadoes and also electrical phenomena, such as lightning.

Another tornado detection scheme is seen in United States Patent Number 5,379,025, issued to Frank B. Tatom et al. on January 3, 1995. This invention monitors seismic waves generated by an impending tornado. By contrast, the present invention does not consider seismic phenomena, looking instead to airborne phenomena. The present

invention predicts electrical phenomena as well as tornadoes and the like.

United States Patent Number 5,444,530, issued to Ting-I Wang on August 22, 1995, describes a remote monitor for airfields which employs distortion of partially coherent light to detect precipitation and identify the same as rain or snow. By contrast, the present invention monitors different parameters of the atmosphere, notably temperature, humidity, barometric pressure, light, and static charge. The present invention infers presence of extreme weather conditions not analyzed by Wang, such as lightning and tornadoes.

None of the above inventions and patents, taken either singly or in combination, is seen to describe the instant invention as claimed.

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SUMMARY OF THE INVENTION

The present invention combines weather detecting apparatus for detecting local conditions with communications apparatus for obtaining information relating to distant weather conditions. From this combination, a user may ascertain current local conditions which are not apparent to the senses and information regarding imminent or otherwise relevant conditions.

This combination of information enables a person to organize his or her activities appropriately. Detection of severe weather phenomena may cause a person to take actions to protect life and property in the immediate vicinity being monitored. Alternatively, a person may select an appropriate location for travel, if avoidance of local weather is required or if previous travel plans must be modified.

The novel weather station thus both analyzes and reports weather conditions. The communication apparatus enables selection of information from any selected location on the globe, and voice synthesizing apparatus for annunciating selected weather information in a selected language. The voice synthesizing apparatus further is capable of offering operating choice selection prompts in synthesized voice form and of responding to verbal selections by the user.

Preferably, weather conditions being monitored by sensing or by gleaning information from remote radio broadcasts relate to violent or severe conditions most

likely to threaten life and property. Ambient characteristics which may be sensed to infer imminent actual weather conditions include temperature, humidity, light intensity, barometric pressure, and potential of ambient static charges. These conditions may then be analyzed by a data processor integral with the weather station to predict imminent weather conditions. The results may be annunciated either by synthesized voice or by indicating lights or the like. In particular, the communications apparatus of the novel weather station is compatible with different international cellular protocols, so that data corresponding to distant weather conditions is obtained by receiving distant local weather condition broadcasts.

The actual apparatus is quite compact, and comprises two separably connected sections. For this reason, the novel weather station is readily portable and easily utilized. A receiver section includes cellular circuitry enabling communications with the external world. A sensor section contains sensors for determining local weather conditions and a microprocessor for accomplishing the various functions of the weather stations. Each of the two separably connected sections has a battery for providing power enabling operation independently of the other respective section.

Accordingly, it is a principal object of the invention to provide a portable weather station which can predict local severe weather conditions.

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It is another object of the invention to provide a portable weather station which can obtain information relating to remote weather conditions.

It is a further object of the invention that the weather station be operated to a significant extent by vocalized prompts.

Still another object of the invention is that the weather station be compatible with a variety of languages.

An additional object of the invention is to cooperate with a variety of international cellular protocols.

It is again an object of the invention that the novel weather station comprise two manually separable sections.

Yet another object of the invention is that the novel weather station carry on board a source of power for its operation.

It is an object of the invention to provide improved elements and arrangements thereof in an apparatus for the purposes described which is inexpensive, dependable and fully effective in accomplishing its intended purposes.

These and other objects of the present invention will become readily apparent upon further review of the following specification and drawings.

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BRIEF DESCRIPTION OF THE DRAWINGS

Various other objects, features, and attendant advantages of the present invention will become more fully appreciated as the same becomes better understood when considered in conjunction with the accompanying drawings, in which like reference characters designate the same or similar parts throughout the several views, and wherein:

Fig. 1 is an environmental, diagrammatic view of the invention.

Fig. 2 is a front plan view of one of the two separable sections of the novel weather station, illustrating control and communications apparatus located on the exterior thereof, this section being referred to as a receiver section.

Fig. 3 is a front plan view of the other of the two separable sections of the novel weather station, illustrating components mounted on the exterior thereof, this section being referred to as a sensor section.

Fig. 4 is an end elevational view of the two sections of the novel weather station united.

Fig. 5 is a side elevational view of Fig. 4.

Fig. 6 is a rear plan view of the sensor section.

Fig. 7 is a rear plan view of the receiver section.

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Fig. 8 is a perspective view of an accessory for supporting the receiver section when disconnected from the sensor section.

Fig. 9 is a diagram of internal data and signal processing components of the receiver section and their interconnections.

Fig. 10 is a diagram of internal data and signal processing components relating to 800 MHz frequency communications, and is an extension of the diagram of Fig. 10.

Fig. 11 is a diagram of internal data and signal processing components and associated interconnections of the sensor section.

Fig. 12 is a diagram of voice recognition circuitry components and interconnections, and is an extension of the diagram of Fig. 10.

Fig. 13 is a diagram of a visual indicator driver and its driven indicators and interconnections therebetween, and is an extension of the diagram of Fig. 10.

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DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Fig. 1 of the drawings shows cooperation between the novel weather analyzing and reporting station 10 and a conventional communications system utilizing cellular technology. The conventional system includes weather satellites, represented by satellite 2, radio receiving and broadcasting facilities, represented by towers 4, and cellular transmission facilities, such as Mobile Telephone Switching Offices, represented by cells 6. Satellite 4, towers 6, and cells 8 are conventional. The novel weather station 10 cooperates with these conventional facilities in gathering weather data.

Weather station 10 comprises two manually separable sections, including a receiver section 12 having radio communication apparatus therein for communicating with an external cellular radio frequency communication system, as represented by cells 6, and a sensor section 14 containing sensors for sensing local ambient weather conditions. Receiver section 12 also contains a microprocessor 16 and a source of power for operating weather station 10. Sections 12 and 14 are removably connected to one another by structure which will be further described hereinafter.

Fig. 2 shows the front panel of receiver section 12, whereon controls, visual displays, and a microphone 18 are mounted. An omnidirectional speaker 20 and a volume control 22 are disposed proximate microphone 18. A visual display 24 indicates date or time. Selector buttons 26, 28 enable selection of date or time to be indicated on display 24. A three digit display 30 is provided for indicating

temperature. Selector buttons 32 and 34 select between Celsius and Fahrenheit scales. A display 36 indicates radio signal strength by progressive illumination of its individual illuminable elements.

A relative temperature display 38 indicates local temperature. A proximity sensor 40 detects whether the user is so close to weather station 10 as to interfere with reception of radio signals. An array 42 of light emitting diodes (LED) is utilized to display information regarding mode of operation. A master on-off switch 44 and a reset button 46 are provided. An emergency light 48 and a switch 50 for a purpose described hereinafter are disposed upon the front panel of receiver section 12. Switch 50 is identified by a bas relief or raised symbol 52 for the benefit of the blind. A T-LED 54 is disposed at the bottom of the front panel.

Fig. 3 shows components mounted on the exterior of sensing section 14. A temperature sensor 56, such as model MTS102, manufactured by Motorola Corporation, is provided to sense ambient temperature. A barometric pressure sensor 58, such as model MPX200A, manufactured by Motorola Corporation, senses ambient air pressure. A humidity sensor 60, such as model Minicap 2/5, manufactured by Panametrics Corporation, senses ambient humidity. A light sensor 62, which may be a model TSL235, as manufactured by Texas Instruments, senses visible light, and a static charge sensor 64, which may be model KML10/B/2, as manufactured by Phillips Semiconductor, senses ambient static potential. Sensors 56, 58, 60, 62, and 64 each incorporate a transducer for generating a data

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signal indicative of values of their respective sensed weather characteristics.

A closure 66 affording access to a battery 67 (concealed in Fig. 3) within sensor section 14 is also disposed upon the exterior of sensor section 14. Battery 67 is preferably a 9 volt lithium battery. A snap 68 for removably connecting sensor section 14 to receiver section 12 is provided. A corresponding second snap 70 (see Fig. 2) is located on receiver section 12.

Fig. 4 shows sections 12 and 14 connected. A screw 72 passes journaled or similarly entrapped within section 12 passes through a bored boss (not shown) formed in section 14. A screw (not shown) similar to screw 72 but oppositely directed is utilized at the opposite, concealed end of sections 12 and 14 to complement screw 72. Sections 12 and 14 are separated or disconnected by removal of these screws. A gold mesh protector 73 protects an antenna (further described hereinafter) serving sensor section 14.

Fig. 5 shows sections 12 and 14 connected, and clearly shows grooves 74, 76 formed in sensor section 14 for manually grasping sensor section 14.

Referring now to Fig. 6, when separated or disconnected, sensor section 14 may be suspended from a selected external or environmental object (not shown) by the following arrangement. Sensor section 14 has a closure 78 which may be opened to reveal a chamber (not shown) and a strip of hook and loop fastener (not shown). The strip of hook and loop fastener extends outside the chamber so that

it may be removably mated with a corresponding patch of hook or loop material (not shown) which has been permanently mounted on the selected environmental object. This arrangement allows temporary support of sensor section 14 in a designated location when not connected to receiver section 12. The chamber enclosing the strip of hook and loop material is sealed to prevent ingress of moisture into sensor section 14.

As shown in Fig. 7, receiver section 12 has an external antenna 80, a stepper motor controller 82, a power supply 84, and a standard DC power connection port 86. Power supply 84 comprises a converter for converting 120 volt AC power to nominal 12 volt DC power and a nominal 12 volt lithium battery. Port 86 is configured to accept any one of many well known connectors. Port 86 is electrically connected to power supply 84, so that supply 84 may be recharged when connected to an external source of power. When not so connected, receiver section 12 derives power from power supply 84.

Fig. 8 illustrates a holder 88 for holding receiver section 12 when separated from sensor section 14. This feature enables receiver section 12 to be supported on any convenient horizontal surface (not shown) when detached or disconnected from sensor section 14.

Externally visible or accessible components of weather station 10 have been described thus far. Internal components and circuitry will now be described, with reference first to Fig. 9. A microprocessor 100 processes incoming data, stores historical data relating to weather,

and manages the system by responding to control commands and issuing prompts where required and providing information to the user by visual and audible outputs. Historical data recorded for a selected immediate area of usage is stored in memory of a flash ROM 102. Microprocessor 100 may be a model 386 microprocessor by Intel Corporation, and flash ROM 102 may be model 28F400BX-T, also by Intel. A voice recognition and simulation system enables bidirectional vocal communication between weather station 10 and the user.

Incoming data is received either from sensor section 14 or by radio transmission from remote, external weather data broadcasting sources, as summarized in Fig. 1. Data derived by sensing is received by antenna 104 and communicated to conventional 49 MHz transmission and reception circuitry 106. Incoming signals are processed by a decoder and encoder 108, and are digitized within an analog-to-digital and digital-to-analog converter 110. Decoder and encoder 108 may be model HT12E/HT12D, by Holtek Corporation. Digitized data is then communicated to microprocessor 100 and flash ROM 102.

Incoming data received from external sources at 800 MHz frequency is processed as follows, referring now to Fig. 10. 800 MHz signals are received by antenna 112 and communicated to a duplex filter 114 which switches between transmission and reception functions. Duplex filter 114 may be model DFY2R836CR881BTJ, by Phillips Semiconductor. Data then passes to an 800 MHz receiver 116 and subsequently to a data processor 118 and to a microcontroller 120. Data processor 118 may be may be model UMA1000, as manufactured by Phillips Semiconductor, and microcontroller 120 may be model 8XC51RA,

as manufactured by Intel. From microcontroller 120, data is passed to a flash ROM 122 (see Fig. 9) and subsequently to microprocessor 100 (see Fig. 9).

800 MHz transmissions by weather station 10 are enabled by a transmission module 124 incorporated into the 800 MHz circuitry shown in Fig. 10. Transmission module 124 may be model BGY110D.

Internal components of sensor section 14 are illustrated in Fig. 11. Sensors 56, 58, 60, 62, 64 communicate with a flash ROM 126 and with a multiplexer 128, which is connected to an encoder and decoder 130. Output of encoder and decoder 130 is transmitted by antenna 132 for reception by antenna 104 of receiving unit 12 (see Fig. 9). Antenna 132 is protected by gold mesh protector 73 shown in Fig. 4. Flash ROM 126 may be model 28F010-15, as manufactured by Intel, and multiplexer 128 may be a model 74151. Encoder and decoder 130 may be a model HT12E/HT12D, as manufactured by Holtek.

Because sections 12 and 14 are separable, each has an internal antenna 104 (see Fig. 9) or 132 for enabling mutual communication. With the exception of sensors 56, 58, 60, 62, 64, antenna 132 and its associated circuitry, and battery 67, all internal components described thus far are located in receiving section 12.

Referring now to Fig. 12, voice simulation and recognition apparatus is also contained within receiver section 12. Voice recognition apparatus includes microphone 18 which is connected to a voice recognition device 136.

Microphone 18 is located on receiver section 12 in any suitable location for receiving responses and commands spoken by the user. Device 136 is a model UPD 77501, as manufactured by NEC, and is a high quality speech recording and playback LSI. Device 136 communicates with a static RAM device 138 and a flash ROM memory device 140. Static RAM device 138 is preferably a 1 meg, 8 byte 128 x 8 RAM device, model MCM 6726, as manufactured by Motorola. Flash ROM device 140 is preferably a model 28F400BX-T, as manufactured by Intel.

Voice simulation apparatus is shown in Fig. 9, and includes a 1 Megabyte speech data ROM integrated chip, or digital speech processor 142. Speech processor 142 is a stand alone masked ROM device, and is preferably a model 7758A, as manufactured by NEC. Output of speech processor 142 is projected from speaker 20.

Also shown in Fig. 9 are operative connection of proximity sensors 40 to microprocessor 100 through an operational amplifier 146, and drivers 148, 150 for driving visual indicators and alarm. Driver 150 is associated with a real time clock 152, and drives date and time indicator 24.

Driver 148 drives many of the visual indicators disposed upon the front exterior surface of receiving section 12. These connections are shown in detail in Fig. 13. In Fig. 13, it will be seen that display 30 comprises three independent display panels 30A, 30B, and 30C, each capable of displaying a different symbol. Similarly, relative temperature display 38 indicates temperature in

several individual steps or range increments by illuminating individual illuminable elements 38A, 38B, 38C, 38D, 38E.

Array 42 of LEDs comprises three independent groups of LEDS 42A, 42B, 42C. This array indicates mode of operation with respect to gathering of broadcast weather data relating to local weather (LEDs 42A), local continent (LEDs 42B), or international continent (LEDs 42C).

Operation of weather station 10 will now be described. Weather station 10 may be operated in any one of three modes. In a local reporting mode, weather station 10 reports conditions, either with sections 12 and 14 connected or separated. The local reporting mode is indicated by illumination of LEDs 42A. A local continent or country reporting mode is signalled by illumination of LEDs 42B. An international or global reporting mode is signalled by illumination of LEDs 42C. Local reporting may proceed with or without connection of sensor section 14. If connected and delivering data, LED 54 will illuminate.

To operate, it is required that switch 42 be on, that proximity sensors 40 detect a person disposed immediately in front of receiver section 12, and that an appropriate voice command or radio frequency signal be received. When the first two conditions are satisfied, reception of a radio signal indicative of severe weather conditions will initiate operation. Microprocessor 100 (see Fig. 9) is provided with a five year history of weather data for the geographic area selected to be monitored, and with algorithms for comparing input data to stored data to determine correlation to severe weather conditions. These weather conditions include

tornadoes, high winds, lightning, high level of rainfall, among others. Correlation of input data with a severe weather condition will cause operation.

If no such correlation is received and the first two conditions for operation are present, a control algorithm will initiate a series of vocalized prompts generated by speech processor 142 and speaker 20 (see Fig. 9). When a verbal response is received, recognized, and correlated to predetermined responses by microphone 18 and associated voice recognition circuitry shown in Fig. 12, commands are executed and further verbal prompts, as appropriate, are generated.

One selection that is made by the user responsive to a prompt is the geographic area that is to be regarded as local. This information may be provided by the user verbally by responding with the latitude and longitude of the selected local area, or with a nearby city and state, according to initial programming of weather station 10.

Certain verbal prompts occur only during initial preparation of weather station 10, and are programmed such that once answered, they will not be repeated at each usage of weather station 10. These prompts concern language selection, as will be discussed hereinafter, and intervals and nature of audible alarms which sound automatically when microprocessor 100 determines that there is a high probability of severe weather conditions. A value relating to threshold of probability of severe conditions may also be included in prompts for initially preparing weather station 10.

When operating in the local reporting mode, sensors 56, 58, 60, 62, 64 periodically sense conditions and transmit collected data to microprocessor 100 for assessment of conditions and annunciation of the same. Routine information such as temperature is indicated on display 30 or relative temperature display 38, which indicates a range rather than specific values, as indicated on display 30. If severe conditions are calculated as probable, an audible alarm in the form of a high pitched tone or a simulated voice message in the selected language is sounded from speaker 20. After the user responds to predetermined verbal prompts to assure that correct selections are made, sensing becomes dormant and will reactivate at predetermined intervals, such as every fifteen minutes.

Memory of weather station 10 is loaded with data corresponding to a selected historic base time period, such as the previous five years. Real time weather data received by antenna 104 is reconfigured by digital-to-analog converter 110 and is routed to microprocessor 100 and to flash ROM 102. Analysis by comparison to known or pre-calculated conditions will generate outputs conducted to visual indicators shown in Fig. 2 and, if predetermined threshold values are met, sound an alarm as described above. In addition to an audible alarm, emergency indicator 48 will illuminate.

Voice recognition utilizes adaptive differential pulse code modulation (ADPCM). Speech processor 142 features lowpass filtering microphone amplifiers with a variable fixed gain ADPCM coder and decoder. Voice recognition device 136 receives a pulse code modulated signal from

microphone 18. The signal is low pass filtered, converted to a ten bit digital value and converted to ADPCM. After conversion by the analog-to-digital converter 110, the signal is encoded to a shortened ADPCM code, such as two, three, or four bits. From the analysis circuit, the data is routed to external memory utilizing static RAM device 138 and associated flash ROM device 140. Data is retrieved when microprocessor addresses the voice recognition circuitry.

In the local reporting mode, LEDs 42A (see Fig. 13) will be illuminated. LED 38E is preferably red in color, and will indicate temperatures exceeding ninety degrees Fahrenheit. LED 38D is preferably amber in color, and indicates temperatures in a range of seventy to ninety degrees. LED 38C is preferably green in color, and indicates temperatures in a range of fifty to seventy degrees. LED 38B is preferably blue in color, and indicates temperatures in a range of thirty to fifty degrees. LED 38A is preferably red in color and indicates temperatures below thirty degrees Fahrenheit.

LED 54 will illuminate when the local reporting mode is in operation. This serves as warning that only local weather data is being reported.

To select a reporting mode, or to change an existing selection, switch 42 is switched to on, or switched to off followed by switching to on, if weather station 10 is already operating. Predetermined simulated voice prompts will request responses in a preselected code. This may comprise a letter or number corresponding to a particular selection, rather than a value or location being selected.

Language of communication is selected at this time. When a language prompt is answered in a preferred language, all responses by the user thereafter will be treated in the selected language, and all simulated voice prompts will be issued in the selected language. It is preferred that the memory of weather station 10 be loaded to include a range of languages for selection. Preferred languages include English, Spanish, German, French, Russian, Arabic, one or more Chinese dialects, Italian, and Japanese.

Within the U.S., NOAA Weather Radio is monitored for the standard 1050 Hz tone employed by the NOAA to indicate an emergency. Detection of this tone preferably triggers an appropriate alarm and may initiate a simulated vocal query to monitor specific severe conditions, such as identified existing hurricanes, tropical storms, and the like.

When selecting the international or global reporting mode, connection with the appropriate remote cellular protocol is arranged by prompts. Memory of weather station 10 is loaded with available international protocols to assure reception of the requested data.

After certain necessary selections have been made, weather station 10 will issue a general query as to other requirements not addressed by prompts. These may be specified by utilizing a prearranged code or signal.

When initial prompts have been satisfactorily answered, a vocal signal will be issued. Preferably, this signal will be a distinctive sound, such as the Boatswain's Whistle.

The Boatswain's Whistle is a melody employed by the U.S. Naval Fleet.

It is to be understood that the present invention is not limited to the embodiments described above, but encompasses any and all embodiments within the scope of the following claims.

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